

IN THE CLAIMS

5 This listing of claims will replace all prior versions, and listings, of claims in the application:

1-21. (Previously Canceled)

10 22. (Previously Amended) A method of generating object-oriented computer programs for accessing and updating persistently stored objects, wherein the method is performed under program control by a computer, the method comprising:

receiving an initial computer program that includes original instructions for accessing objects stored in a computer's main memory, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

15 scanning the initial computer program to automatically identify object accessing instructions and corresponding program locations at which additional instructions are to be added representing a first set of identified program locations;

20 automatically, under computer program control, revising the initial computer program to generate a revised computer program by modifying data structures of the persistent objects and adding object loading instructions to the initial computer program at the first set of the identified program locations, wherein the added object loading instructions, during execution of the revised computer program, load respective ones of the persistent objects from persistent storage of the computer into the main memory when each respective object is accessed and the respective object is not already in the main memory.

23. (Original) The method of claim 22, wherein the added object loading instructions are inactive during execution of the revised computer program except when a respective object to be accessed is referenced by a null location indicator.

24. (Original) The method of claim 22,
the revising further includes:

adding dirty object marking instructions to the initial computer program that, during execution of the revised computer program, store object marking data indicating which objects in the main memory contain new and/or updated data; and

adding object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective objects in the main memory into the persistent storage;

wherein the certain respective objects stored into the persistent storage by the object storing instructions contain new and/or updated data as indicated by the object marking data.

25. (Original) The method of claim 24, wherein the object storing instructions include instructions for replacing main memory object references in the certain respective objects with corresponding persistent storage object identifiers before storing the certain respective objects in the persistent storage.

26. (Previously Amended) A method of generating object-oriented computer programs for accessing and updating persistently stored objects, wherein the method is performed under program control by a computer, the method comprising:

receiving an initial computer program that includes original instructions for accessing and updating objects stored in a computer's main memory and for committing transactions in which one or more objects may have been updated, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

scanning the initial computer program to automatically identify object updating instructions and transaction commit instructions and corresponding program locations at which additional instructions are to be added representing a set of identified program locations;

automatically, under computer program control, revising the initial computer program to generate a revised computer program by:

modifying data structures of the persistent objects;

adding at a first subset of the identified program locations dirty object marking instructions to the initial computer program that, during execution of the revised computer

program, store object marking data indicating which objects in the computer's main memory contain new and/or updated data; and

adding at a second subset of the identified program locations object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective objects in the computer's main memory into the persistent storage, wherein the object marking data stored by the dirty object marking instructions is used by the object storing instructions to identify the certain respective objects.

27. (Original) The method of claim 26, wherein the object storing instructions include instructions for replacing local object references in the certain respective objects with corresponding persistent storage object identifiers before storing the certain respective objects in the persistent storage, wherein the local object references reference objects in the main memory and the persistent storage object identifiers reference objects in the persistent storage.

28. (Previously Amended) A method of generating object-oriented computer programs for accessing and updating persistently stored objects, wherein the method is performed under program control by a computer, the method comprising:

scanning an initial computer program to automatically identify object accessing instructions and object updating instructions and corresponding program locations at which additional instructions are to be added, the initial computer program including original instructions for accessing and updating objects stored in a computer's main memory, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

automatically revising the initial computer program to generate a revised computer program by modifying data structures of the persistent objects and adding supplemental instructions to the initial computer program at the identified program locations, the supplemental instructions including:

a first set of additional instructions, added to the initial computer program at a first subset of the identified program locations associated with identified object accessing instructions, wherein the first set of additional instructions, during execution of the revised computer program,

perform a first predefined task when each respective object is accessed and the respective object is not already in main memory of the computer; and

20 a second set of additional instructions, added to the initial computer program at a second subset of the identified program locations associated with the identified object updating instructions, wherein the second set of additional instructions, during execution of the revised computer program, perform a second predefined task when each respective object is updated for a first time.

29. (Original) The computer implemented method of claim 28, wherein the first predefined task includes loading respective ones of the objects from persistent storage of the computer into the main memory of the computer when each respective object is accessed and the respective object is not already in the main memory.

30. (Original) The computer implemented method of claim 29, wherein the second predefined task includes storing object marking data indicating which objects in the main memory contain new and/or updated data.

31. (Original) The computer implemented method of claim 29, wherein the scanning includes scanning the initial computer program to automatically identify transaction commit instructions and corresponding program locations at which further additional instructions are to be added to the initial computer program;

5 the revising includes adding at a third subset of the identified program locations object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective objects in the computer's main memory into the persistent storage, wherein the object marking data stored by the dirty object marking instructions is used by the object storing instructions to identify the certain respective objects.

32. (Previously Amended) A computer program product for use in a conjunction with a computer having a main memory and persistent storage, the computer program product comprising a computer readable storage medium and a computer program mechanism embedded therein, the computer program mechanism comprising:

5 a postprocessor procedure for modifying an initial computer program that includes original instructions for accessing and updating objects stored in a computer's main memory, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

the postprocessor procedure including instructions for:

10 receiving an initial computer program that includes original instructions for accessing objects stored in a computer's main memory;

scanning the initial computer program to automatically identify object accessing instructions and corresponding program locations at which additional instructions are to be added representing a first set of identified program locations;

15 automatically, under computer program control, revising the initial computer program to generate a revised computer program by modifying data structures of the persistent objects and adding object loading instructions to the initial computer program at the first set of the identified program locations, wherein the added object loading instructions, during execution of the revised computer program, load respective ones of the persistent objects from persistent
20 storage of the computer into the main memory when each respective object is accessed and the respective object is not already in the main memory.

33. (Original) The computer program product of claim 32, wherein the added object loading instructions are inactive during execution of the revised computer program except when a respective object to be accessed is referenced by a null location indicator.

34. (Original) The computer program product of claim 32, wherein the revising instructions further include instructions for:

5 adding dirty object marking instructions to the initial computer program that, during execution of the revised computer program, store object marking data indicating which objects in the main memory contain new and/or updated data; and

adding object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective objects in the main memory into the persistent storage;

10 wherein the certain respective objects stored into the persistent storage by the
object storing instructions contain new and/or updated data as indicated by the object marking
data.

35. (Original) The computer program product of claim 34, wherein the object storing
instructions include instructions for replacing main memory object references in the certain
respective objects with corresponding persistent storage object identifiers before storing the
5 certain respective objects in the persistent storage.

36. (Previously Amended) A computer program product for use in conjunction with
a computer having a main memory and persistent storage, the computer program product
comprising a computer readable storage medium and a computer program mechanism embedded
therein, the computer program mechanism comprising:

5 a postprocessor procedure for modifying an initial computer program that includes
original instructions for accessing and updating objects stored in a computer's main memory, the
original instructions including instructions for accessing persistent objects comprising main
memory copies of persistently stored objects;

the postprocessor procedure including instructions for:

10 receiving an initial computer program that includes original instructions for
accessing and updating objects stored in a computer's main memory and for committing
transactions in which one or more objects may have been updated;

15 scanning the initial computer program to automatically identify object updating
instructions and transaction commit instructions and corresponding program locations at which
additional instructions are to be added representing a set of identified program locations;

automatically, under computer program control, revising the initial computer
program to generate a revised computer program by:

modifying data structures of the persistent objects;

20 adding at a first subset of the identified program locations dirty object
marking instructions to the initial computer program that, during execution of the revised

computer program, store object marking data indicating which objects in the computer's main memory contain new and/or updated data; and

25 adding at a second subset of the identified program locations object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective objects in the computer's main memory into the persistent

storage, wherein the object marking data stored by the dirty object marking instructions is used by the object storing instructions to identify the certain respective objects.

37. (Original) The computer program product of claim 36, wherein the object storing instructions include instructions for replacing local object references in the certain respective objects with corresponding persistent storage object identifiers before storing the certain
5 respective objects in the persistent storage, wherein the local object references reference objects in the main memory and the persistent storage object identifiers reference objects in the persistent storage.

38. (Previously Amended) A computer program product for use in conjunction with a computer having a main memory and persistent storage, the computer program product comprising a computer readable storage medium and a computer program mechanism embedded therein, the computer program mechanism comprising:

5 a postprocessor procedure for modifying an initial computer program that includes original instructions for accessing and updating objects stored in a computer's main memory, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

the postprocessor procedure including instructions for:

10 scanning an initial computer program to automatically identify object accessing instructions and object updating instructions and corresponding program locations at which additional instructions are to be added;

automatically revising the initial computer program to generate a revised computer program by modifying data structures of the persistent objects and adding supplemental

15 instructions to the initial computer program at the identified program locations, the supplemental instructions including:

a first set of additional instructions, added to the initial computer program at a first subset of the identified program locations associated with identified object accessing instructions, wherein the first set of additional instructions, during execution of the revised computer program,
20 perform a first predefined task when each respective object is accessed and the respective object is not already in main memory of the computer; and

a second set of additional instructions, added to the initial computer program at a second subset of the identified program locations associated with the identified object updating instructions, wherein the second set of additional instructions, during execution of the revised
25 computer program, perform a second predefined task when each respective object is updated for a first time.

39. (Original) The computer program product of claim 38, wherein the first predefined task includes loading respective ones of the objects from persistent storage of the computer into the main memory of the computer when each respective object is accessed and the respective object is not already in the main memory.

40. (Original) The computer program product of claim 39, wherein the second predefined task includes storing object marking data indicating which objects in the main memory contain new and/or updated data.

41. (Original) The computer program product of claim 39, wherein the scanning instructions include instructions for scanning the initial computer program to automatically identify transaction commit instructions and corresponding program locations at which further additional instructions are to be added to the initial computer
5 program;

the revising instructions include instructions for adding at a third subset of the identified program locations object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective objects in the computer's main memory into the persistent storage, wherein the object marking data stored by

10 the dirty object making instructions is used by the object storing instructions to identify the certain respective objects.

42. (Previously Amended) A computer system, comprising:

a central processing unit;

memory, including a main memory for temporarily storing objects and persistent storage for durably storing objects;

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the memory further storing an initial computer program and a postprocessor procedure, executable by the central processing unit, for modifying an initial computer program so as to generate the revised computer program, the initial computer program including original instructions for accessing objects stored in the main memory, the original instructions including instructions for accessing persistent objects comprising main memory copies of persistently stored objects;

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the postprocessor procedure including instructions for:

receiving an initial computer program that includes original instructions for accessing objects stored in a computer's main memory;

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scanning the initial computer program to automatically identify object accessing instructions and corresponding program locations at which additional instructions are to be added representing a first set of identified program locations;

automatically, under computer program control, revising the initial computer program to generate a revised computer program by modifying data structures of the persistent objects and adding object loading instructions to the initial computer program at the first set of the identified program locations, wherein the added object loading instructions, during execution of the revised computer program, load respective ones of the persistent objects from persistent storage of the computer into the main memory when each respective object is accessed and the respective object is not already in the main memory.

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43. (Original) The computer system of claim 42, wherein the added object loading instructions are inactive during execution of the revised computer program except when a respective object to be accessed is referenced by a null location indicator.

44. (Original) The computer system of claim 42, wherein the revising instructions further include instructions for:

adding dirty object marking instructions to the initial computer program that, during execution of the revised computer program, store object marking data indicating which objects in the main memory contain new and/or updated data; and

adding object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective objects in the main memory into the persistent storage;

wherein the certain respective objects stored into the persistent storage by the object storing instructions contain new and/or updated data as indicated by the object marking data.

45. (Original) The computer system claim 44, wherein the object storing instructions include instructions for replacing main memory object references in the certain respective objects with corresponding persistent storage object identifiers before storing the certain respective objects in the persistent storage.

46. (Previously Amended) A computer system, comprising:

a central processing unit;

memory, including a main memory for temporarily storing objects and persistent storage for durably storing objects;

the memory further storing an initial computer program and a postprocessor procedure, executable by the central processing unit, for modifying an initial computer program so as to generate the revised computer program, the initial computer program including original instructions for accessing objects stored in the main memory, the original instructions including instructions for persistent objects comprising main memory copies of persistently stored objects;

the postprocessor procedure including instructions for:

receiving an initial computer program that includes original instructions for accessing and updating objects stored in a computer's main memory and for committing transactions in which one or more objects may have been updated;

15 scanning the initial computer program to automatically identify object updating instructions and transaction commit instructions and corresponding program locations at which additional instructions are to be added representing a set of identified program locations;

automatically, under computer program control, revising the initial computer program to generate a revised computer program by:

modifying data structures of the persistent objects;

20 adding at a first subset of the identified program locations dirty object marking instructions to the initial computer program that, during execution of the revised computer program, store object marking data indicating which objects in the computer's main memory contain new and/or updated data; and

25 adding at a second subset of the identified program locations object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective objects in the computer's main memory into the persistent storage, wherein the object marking data stored by the dirty object marking instructions is used by the object storing instructions to identify the certain respective objects.

47. (Original) The computer system of claim 46, wherein the object storing instructions include instructions for replacing local object references in the certain respective objects with corresponding persistent storage object identifiers before storing the certain
5 respective objects in the persistent storage, wherein the local object references reference objects in the main memory and the persistent storage object identifiers reference objects in the persistent storage.

48. (Previously Amended) A computer system, comprising:
a central processing unit;
memory, including a main memory for temporarily storing objects and persistent storage for durably storing objects:

5 the memory further storing an initial computer program and a postprocessor procedure, executable by the central processing unit, for modifying an initial computer program so as to generate the revised computer program, the initial computer programming including original instructions for accessing objects stored in the main memory, the original instructions including instructions for accessing persistent objects comprising main memory copies of
10 persistently stored objects;

the postprocessor procedure including instructions for:

scanning an initial computer program to automatically identify object accessing instructions and object updating instructions and corresponding program locations at which additional instructions are to be added;

15 automatically revising the initial computer program to generate a revised computer program by modifying data structures of the persistent objects and adding supplemental instructions to the initial computer program at the identified program locations, the supplemental instructions including:

a first set of additional instructions, added to the initial computer
20 program at a first subset of the identified program locations associated with identified object accessing instructions, wherein the first set of additional instructions, during execution of the revised computer program, perform a first predefined task when each respective object is accessed and the respective object is not already in main memory of the computer; and

a second set of additional instructions, added to the initial
25 computer program at a second subset of the identified program locations associated with the identified object updating instructions, wherein the second set of additional instructions, during execution of the revised computer program, perform a second predefined task when each respective object is updated for a first time.

49. (Original) The computer system of claim 48, wherein the first predefined task includes loading respective ones of the objects from persistent storage of the computer into the main memory of the computer when each respective object is accessed and the respective object is not already in the main memory.

50. (Original) The computer system of claim 49, wherein the second predefined task includes storing object marking data indicating which objects in the main memory contain new and/or updated data.

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51. (Original) The computer system of claim 49, wherein the scanning instructions include instructions for scanning the initial computer program to automatically identify transaction commit instructions and corresponding program locations at which further additional instructions are to be added to the initial computer

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program;

the revising instructions include instructions for adding at a third subset of the identified program locations object storing instructions to the initial computer program that, during execution of the revised computer program, store certain respective objects in the computer's main memory into the persistent storage, wherein the object marking data stored by the dirty object marking instructions is used by the object storing instructions to identify the certain respective objects.

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